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International Letters of Chemistry, Physics and Astronomy

2 (2014) 11-14 ISSN 2299-3843

Potential Gravitational - Solar Electromagnetic Spectral Radiance Interaction as the Source of the Earth's Background Free Oscillations

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ABSTRACT

The origins of the continuous free oscillations of the whole earth have been attributed to coupling between the solid earth and atmosphere primarily through the fundamental spheroidal mode ${}_0S_{29}$ oscillation of ~3.7 mHz. The origins of these interference patterns have been attributed to an excitation source just above the Earth's surface. However, comparable surface oscillations have been measured in the Sun's photosphere. The cube root of the product of the gravitational constant, the spectral radiance of the sun, and the square of the frequency produced an acceleration value that was identical to the measured amplitude of the free Earth oscillations ($\sim 0.4 \cdot 10^{-11}$ m·s^{-2}). The quantitative convergence suggests these narrow-band accelerations may emerge within the Sun-Earth system as it moves through galactic space.

***Keywords*:** Earth's free oscillations; gravitation; solar Rossby waves; nanoGals; spheroidal modes; solar spectral radiance

1. INTRODUCTION

Masses with mechanical properties have the capacity to oscillate as a function of their physical and geometric characteristics. The earth is a mass. It displays background free oscillations of between 2 and 7 mHz in seismic records during days without significant earthquakes. Rhie and Romanowicz [1] showed that the earth's "hum" appeared to originate primarily over the northern Pacific Ocean during winter in the Northern Hemisphere and in the southern equivalents during winter in the Southern Hemisphere. These oscillations comprise fundamental spheroidal modes and exhibit daily excitations comparable to 5.8 to 6.0 M earthquakes [1] or the energy equivalence of ~10^{18} J. The correlative amplitudes are in the range of $0.5 \cdot 10^{-11}$ m·s^{-2} (1 nGal = 10^{-11} m·s^{-2}), exhibit relatively minimal frequency dependence, and cannot be easily accommodated by the cumulative effects of small earthquakes [2].

The coupling between seismic and atmospheric acoustic modes could help reveal their commonality or source. Raleigh waves or surface ripples with periods of ~270 s and ~230 s

have been associated with volcanic eruptions due to the continuous flux of thermal energies that initiate standing infrasonic (acoustic) waves within the atmosphere. Interference between two topographical mechanical waves propagating from opposite directions produces standing waves with spherical oscillations (S). The two periods of the Raleigh waves were interpreted according to normal mode theory where 270 s corresponded to spherical mode $_0S_{29}$ coupled to atmospheric acoustic modes and 230 s corresponded to $_0S_{37}$ associated with a primary overtone.

Nishada et al (2) measured two conspicuous peaks in the amplitude of the spectral density of the fundamental spheroidal modes for the continuously excited free oscillations of the whole earth. Between spheroidal mode number 15 and 50, the primary enhancement of amplitude (~0.1 nGal) occurred at $_0S_{29}$ (3.7 mHz) with a secondary peak (0.05 nGal) at $_0S_{37}$. These modes corresponded to 3.7 mHz and 4.3 mHz, respectively. For comparison the gradual increase in amplitude between mode number 15 and 50 ranged between 0.2 and 0.6 nGal. This clear congruence with Raleigh waves indicated that specific bands of excitation of seismic modes couple to atmospheric acoustic modes. Nishada et al (2) concluded that the association could be understood only if the two systems, the atmosphere and the solid earth, were viewed as a single coupled system, and, that the source of these seismic-free oscillations is at or just above the earth's surface.

The annual variation of amplitude in $_0S_{29}$ ranged from 0.4 to $0.6 \cdot 10^{-11}$ $m \cdot s^{-2}$ (0.4 to 0.6 nGal) with a peak during the summer months. Superimposition of the global average of infrared flux at the top of the atmosphere upon the annual variations revealed a congruent peak (242 $W \cdot m^{-2}$) that reflected ~5 % of the mean value. Persinger [3] demonstrated that the oscillation amplitudes of daily spectral patterns of background photon emissions (as measured by photomultiplier tubes) around 3 mHz also reflected these annual variations. Nishada et al [2] concluded that the coincidence of the oscillation amplitudes during the earth year indicated that the dynamic pressure of atmospheric origin excites the free oscillations of the Earth.

However the inertial frames of the earth are intrinsically coupled to the Sun's mass as the solar system move through the galaxy. If the background free oscillations that couple the atmosphere and solid earth are related to this third factor then the sun should display the equivalent of a comparable mode. The differential rotation between the Sun's polar (slower) and equatorial photosphere has been attributed to Rossby-like waves or r-mode oscillations. Kuhn et al [4] detected convexities with peak-to-peak values of ~100 m distributed uniformly over the photosphere of the solar surface. The spacing was between 8.1 and $9.3 \cdot 10^7$ m. If c is assumed as the velocity, the intrinsic periodicity or fundamental resonance would be within the 3.2 to 3.7 mHz. The latter is precisely the $_0S_{29}$ mode frequency reported for the solid earth-atmospheric system.

In the present paper I present a model that supports the proposition that the source, as defined by the congruent quantification for amplitudes of the oscillations, of the earth's background free-oscillations could originate from the Sun's activity within a gravitational field. If one assumes the resonance of any coupled system is markedly influenced by the applied constant energies that envelope it, then the role of gravitational and electromagnetic influences from the sun upon the earth as the entire system moves through the galaxy should be considered. The quantification of these two field conditions and specific temporal oscillations should be equivalent to the observed amplitudes that couple the earth-atmospheric system.

2. THE MODEL

The model assumes that the combination (multiplication) of gravitational and electromagnetic fields and their intrinsic frequency produces an acceleration that defines the amplitude of the free oscillations produced by this interaction. In other words:

$$a = \sqrt[3]{(G \cdot E_{ev} \cdot f^2)} \quad (1),$$

where G is the gravitational constant, E_{ev} is spectral irradiance ($W \cdot m^{-2} Hz^{-1}$) and f is the frequency. By dimensional analysis, the product of G ($m^3 \cdot kg^{-1} s^{-2}$), E_{ev} ($kg \cdot s^{-2}$) and the square of the oscillation or period (s^{-2}) results in the units: $m^3 \cdot s^{-6}$. The cube root of that term is acceleration. For this to be potentially valid both G and the spectral radiant emittance must be more or less continuous.

The range of the "persistent" emission of energy from the sun is between 67 and 300 sfu (solar flux units). For the primary calculation the median of 183 sfu is assumed. Because each flux unit is 10^{-22} $W \cdot m^{-2}$ Hz^{-1}, the total spectral radiant emittance is $1.83 \cdot 10^{-20}$ $W \cdot m^{-2}$ Hz^{-1}. This value multiplied by G ($6.67 \cdot 10^{-11}$ $m^3 \cdot kg^{-1} s^{-2}$ and the square of the upper range of the earth's free oscillation (7 mHz), that is $4.9 \cdot 10^{-5}$ s^{-2}, would be $59.8 \cdot 10^{-37}$ $m^3 \cdot s^{-6}$ or $0.4 \cdot 10^{-11}$ $m \cdot s^{-2}$ or 0.4 nGal. This solution is precisely within measurement error of the coefficient and order of magnitude that has been measured [2].

In fact the upper limit for sfu and the lower limit for periodicity and the lower limit for sfu and the upper limit for periodicity result in an acceleration term of ~0.3 nG. At the lower bound level the acceleration term would be within the range of 0.05 to 0.1 nGal which was the enhancement noted for the two spheroidal modes or windows that coupled solid earth and atmospheric background free oscillations of the Earth.

3. DISCUSSION

Nishida et al [2] concluded that background free oscillations represent the hum of the solid Earth. They concluded this perturbation was resonant with the hum of the atmosphere coupled through the two frequency windows, the largest of which was around 3.7 mHz. This is the same range of periodicity associated with oscillations across the solar surface. The monthly fluctuations in this mode number and the power of infrared flux would be consistent with the existence of a solar-terrestrial process that shares a common temporal variation.

Although the Sun may be the primary zeitgeber for this value, there is also the possibility that the shared features are related to the movement of the solar system through galactic space. If the separation between the standing waves in the solar photosphere ($8.7 \cdot 10^7$ m) is compared to its equatorial circumference ($4.79 \cdot 10^9$ m) there would be about 500 components to this spatial gradient. In comparison interference patterns reflected in the free oscillations around the spherical mode of angular degree 29 ($_0S_{29}$) that are distributed globally over the Earth exhibit correlation lengths less than $6 \cdot 10^5$ m. This would produce the same order of magnitude of components. Such similarity of spatial gradients within two bodies with such different masses and diameters would suggest a third factor source.

The biological and chemical consequences of the persistently enhanced acceleration for this resonance may be significant. A 1.5 kg mass, such as the human brain, exposed to $0.5 \cdot 10^{-11}$ $m \cdot s^{-2}$ would result in a force of $3 \cdot 10^{-11}$ N and when applied over the average diameter of the cerebrum of about 11 cm, would be associated with the energy of $4.5 \cdot 10^{-12}$ J. When

multiplied by the frequency $3.7 \cdot 10^{-3}$ Hz, the power would be $\sim 1.7 \cdot 10^{-14}$ W. However the irradiance associated with this power across the cerebral area ($\sim 10^{-2}$ m^2) would be in the order of 10^{-12} $W \cdot m^{-2}$. Interestingly this is within the range of photon emissions as measured by photon multiplier tubes from cerebrums of human subjects when they sit in the dark and engage in specific imaginations [5].

4. CONCLUSIONS

The marked similarity of the modal frequency of "interference" waves over the surface of the Sun and the coupling between the Earth's primary background free oscillations and the lower atmosphere suggest that the latter may not originate exclusively from an excitation source just above the terrestrial surface. The convergence for the specific quantitative acceleration values derived from the constant for gravitation and the spectral irradiance of the sun when this specific "infrasonic" acoustic frequency, and, the actual values measured by multiple methods indicate a source within the solar-earth system.

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(Received 11 October 2013; accepted 16 October 2013)